PEGGY GREB (D1548-1)

Plant physiologist Fitzgerald Booker prepares to place an optical scanner into a tube positioned in the soil to photograph soybean roots. The photos will show changes in root growth caused by elevated carbon dioxide and ozone, pumped into the open-top field chambers.

Ozone Erodes CO_2 Benefits for Plants

Experiments by Agricultural Research Service scientists at Raleigh, North Carolina, and Urbana, Illinois—and their university colleagues—have shown that future higher levels of ozone may cancel out some of the benefits to crops expected from higher carbon dioxide (CO_2) levels.

For one thing, crops wouldn't achieve the 30-percent increase in photosynthesis—and resulting higher yields—expected as CO_2 levels continue to rise.

The scientists have also found that ozone can thwart expected high CO_2 benefits by lowering crop quality. It can also help invasive weeds outcompete forage and other crops.

"We are beginning to look at interactions between ozone and diseases such as stripe rust and stem rust of wheat," says David Marshall, research leader of the Plant Science Research Unit at Raleigh, and an expert on wheat rusts.—**By Don Comis,** ARS.

ARS National Research Program for Air Quality

To the public, air quality and agriculture may not seem that connected. There are, however, critical interactions between farming and the atmosphere—from dust storms to emissions from agrochemicals and animals to carbon dioxide impact on yield. In some cases, we are just beginning to scientifically understand these interactions and how they can be managed.

The impacts of agriculture on the atmosphere must be mitigated, especially when there is a risk to soil, water, and air quality or to human and animal health. For the farmer, emissions from agrochemicals, especially nitrogen, also constitute an economic loss. Limiting economic losses as well as environmental impacts requires new technologies and information to manage and ultimately reduce emissions.

The Agricultural Research Service research program for air quality is focused on developing such understanding and technologies through many projects, which fall under national programs including Climate Change, Soils, and Emissions (#212), Agricultural and Industrial Byproducts (#214), and Food Animal Production (#101).

Research priorities are set through input from customers and stakeholders, including other federal agencies such as the USDA Natural Resources Conservation Service, the U.S. Environmental Protection Agency, the Agricultural Air Quality Task Force Federal Advisory Committee, and the agricultural air-quality science community.

ARS seeks to understand, predict, and manage emissions from plant and animal operations and postharvest processing systems. There is a notable lack of emissions data from production and processing facilities. Existing data is often limited to short time periods and small areas, which in turn limits our ability to asses the effects on local and regional ecosystems and regional air quality. Whole-farm emissions assessments are virtually absent. Consequently, policymakers are hard-pressed to develop regulations based on science.

ARS is working to develop the ability to characterize emissions of soil particulates, volatile organic chemicals, pesticides, nitrogen, and greenhouse gases, and to identify their sources. Process-simulation models that can run on easily collected data are being developed and will provide the foundations for decision-support tools.

Air quality also affects crop growth and yield, so ARS researchers are working to understand how to increase the resilience of agriculture to atmospheric changes such as increasing ozone and carbon dioxide.

ARS air-quality researchers have formed an Air Quality Researchers Working group to better coordinate research across programmatic and scientific disciplines. Collectively, these scientists are addressing the need for standardized measurements, building a database, and planning joint research activities to leverage financial and expertise resources. This effort includes creating mobile instrumentation facilities, such as those used for measuring particulate-matter emissions, and a lightweight lidar system suitable for detecting and measuring emissions over entire farms.

Part of this working group is focused on emissions of greenhouse gases from animal systems, thus merging the strengths of air-quality research science with the successful GRACEnet project. GRACEnet is a nationwide research program to identify agricultural practices that will reduce agricultural greenhouse gas emissions and enhance soil carbon sequestration and provide a sound scientific basis for carbon credit trading programs.

Agriculture must continually increase production in an environmentally friendly way to meet increasing global need for food and other products from renewable resources. Research is the most promising way to achieve these goals.